the decided change to colder of the period 3d–6th.—*F. J. Walz, District Forecaster.*

CHICAGO FORECAST DISTRICT.

The weather was milder than usual thruout the district, except in the eastern portion, and the cold waves were few and not, as a rule, severe. The only cold wave that swept the entire district was the one which appeared in the British northwest on the morning of February 1. It pushed southward and eastward, and by the morning of the 3d had practically covered the entire district, zero temperatures and below prevailing almost generally. The cold waves later in the month were moderate, and pushed down from Manitoba over the upper Lake region and the sections lying to the east of this district. Warnings were issued well in advance of these cold waves.

The storm which ushered in the cold wave during the 1st of the month caused gales on Lake Michigan. The storms later in the month were unimportant. Advisory messages were issued in advance to transportation companies that maintain winter service, and no casualties were reported.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.

The month was remarkable for the uniformly high temperatures that prevailed thruout the district. At many stations the monthly mean was the highest recorded. Precipitation was light on the eastern slope, while over the Plateau region there was a general excess.

The only cold wave of the month occurred in Wyoming and northeastern Colorado on the 2d; it was covered by special warnings issued on the 1st.—*P. McDonough, Local Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.

The beginning of the month was marked by showery weather in the northern portion of the State. A moderate depression off the Oregon coast moved rapidly southeastward thru northern California and Nevada. The presence of a high area off the coast of central California apparently prevented a direct southerly extension of the depression. A period of fair weather followed and on the 7th foehn effects were noticed in southern California, the air coming from the northeast over the mountains and resulting high temperatures being noticed. The pressure distribution for more than ten days was typical of fair, pleasant weather in California. On the 14th, however, local showers occurred at Sacramento and San José, a light thunderstorm occurring at the latter place. These isolated disturbances were not anticipated and are not easily explained without more detailed knowledge of local conditions. On the 16th a widespread but rather flat depression caused moderate rains thruout the State. As a disturbance it seemed to have little energy. On the 21st a well-marked depression, moving slowly, crost California to the valley of the Colorado.

The month as a whole was singularly free from deep and energetic northern coast disturbances. There were few frosts. The month was without storm warnings, a unique experience for the forecaster.—*Alexander G. McAdie, Professor and District Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.

The opening and closing days of the month were stormy. Between the 6th and the 23d the weather was unusually quiet, being controlled by a series of high pressure areas that caused light winds, mild temperatures, and clear weather to prevail. Timely warnings were issued for all storms, and no noteworthy casualties are known to have occurred on account of stress of weather. The rains attending the storms at the beginning of the month caused a flood in the Willamette River, a full account of which will be found elsewhere in this issue.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

The flood in the lower Mississippi during January and February, 1907, was purely an Ohio River flood, as the Arkansas, Red, and Yazoo rivers were at moderate stages. The antecedent conditions responsible for its conception and development were described in the MONTHLY WEATHER REVIEW for January, 1907, and need not be repeated.

The river first rose above the flood stage of 45 feet at Cairo, Ill., on January 21, and did not fall below the flood stage of 16 feet at New Orleans, La., until March 6, a period of forty-five days. As a matter of fact the river at New Orleans rose to flood stage on January 14 on account of an earlier tide in the river, making in all fifty-two consecutive days of flood water.

Notwithstanding the fact that the crest stage of 40.3 feet at Memphis exceeded all previous records, the actual flood volume was less than those of 1897, 1903, and 1904. In 1903 at Memphis the river was above the flood stage for fifty-four days, but in 1907 for only twenty-two days, and at New Orleans for eighty-five days in 1903 against fifty-two days in 1907. The increased stage at Memphis in 1907 was due to the fact that there were no crevasses above, while in 1903 there were two in the Arkansas levee. The closure of Bayou Lafourche since 1903 also operated to somewhat increase the lower river stages between the mouth of the bayou and the mouth of the river. More complete mention is made of these points in the detailed report which follows. While there was much alarm at times, with a rush to the defense of the levees, and some extremely critical situations developed, the damage done was comparatively small, owing principally to the early season.

Warnings of the fullest character were issued from five to twenty days in advance, with daily forecasts until the waters subsided, and an inspection of the table following will show the high degree of accuracy attained:

Station.	Stage forecast.	Actual stage.	Difference.
	Feet.	*Feet.*	
Cairo, Ill	50.0 to 50.6	50.4	0.0
New Madrid, Mo	39.0	38.7	+0.3
Memphis, Tenn	40.0, a little over.	40.3	0.0
Helena, Ark	50.0, about.	50.4	−0.4
Arkansas City, Ark	52.0	52.1	−0.1
Greenville, Miss	47.5	47.3	+0.2
Vicksburg, Miss	50.0, close to.	49.7	+0.3
Natchez, Miss	49.5	48.9	+0.6
Baton Rouge, La	37.0 to 38.0	37.3	0.0
New Orleans, La	20.0	19.8	+0.2
Atchafalaya River.			
Simmesport, La	42.0	42.5	−0.5
Melville, La	38.0	37.7	+0.3

In the next table will be found the dates between which the river was above the flood stage at the various river stations, together with the total number of days. A hydrograph showing the stages from day to day will be found in Chart IX.

Above flood stage.

Station.	From—	To—	No. of days.
Cairo, Ill	January 21	February 5	16
New Madrid, Mo	January 20	February 8	20
Luxora, Ark	January 28	February 7	11
Memphis, Tenn	January 22	February 12	22
Helena, Ark	January 13	February 15	34
Arkansas City, Ark	January 10	February 22	44
Greenville, Miss	January 20	February 19	31
Vicksburg, Miss	January 23	February 23	32
Natchez, Miss	February 1	February 25	25
Baton Rouge, La	February 6	February 27	22
Donaldsonville, La	February 5	February 27	23
New Orleans, La	January 14	March 6	52

The following are the reports in detail of the floods in the various districts:

Cairo, Ill., to Memphis, Tenn., by Mr. S. C. Emery, official in charge of local office, U. S. Weather Bureau, Memphis, Tenn.

During the preceding summer months the Mississippi from below Cairo to Helena was considerably above the usual stage for that season. In October and November the river rose to

greater heights than ever before known in those months, while the maximum stage for the month of December has been exceeded but once during the last thirty-six years.

From November 17 to 21 occurred one of the most remarkable downpours of rain ever known in this section. The rainfall at Memphis during those five days amounted to 14.11 inches, and thruout western Tennessee and northern Mississippi the fall was equally great, and in some localities even greater. The natural effect of this great downpour was the raising of all the local streams to flood heights. The Wolf, Hatchie, and Forked Deer rivers, streams emptying into the Mississippi from the east between Cairo and Memphis, were out of their banks and all the adjacent lowlands were severely inundated. For several days railroad traffic was practically suspended on several lines entering Memphis and on all it was more or less impeded. Many bridges were washt away by the flood and county roads badly damaged. As these waters were suddenly poured into the Mississippi, its rise was unusually rapid, and during the six days following the beginning of the rise at Memphis the river rose 18 feet, an average of 3 feet daily. Under normal conditions an increase of 1 foot in twenty-four hours is considered quite rapid.

The crest of the rise reached Memphis on November 30 and Helena on December 2, with stages of 29.5 and 37.3 feet, respectively.

On December 1 the stage at Memphis was 29.2 feet, but by December 14 it had fallen to 13.5 feet, when a second swell set in which reached its maximum at Memphis on December 27 with a stage of 25.7 feet. Two days later the river came to a stand at Helena with a stage of 34.1 feet. After December 27 the river fell very slowly for six or seven days, and on January 4 the third important rise of the series began to be felt at Memphis. Considering the high condition of the river at the beginning, this rise was very rapid, the increase amounting to 11 feet in eight days. The swollen condition of all streams in this district, taken in connection with the great volume of water then moving down the Ohio and the general rains in progress over the watershed, strongly indicated that bank-full stages would soon prevail in this section. Accordingly on January 9 a special warning bulletin was issued and distributed over the territory most likely to be affected. This bulletin gave notice that flood stages would be reached at all points between New Madrid and Helena within the next ten days, and that the following maximum stages were expected: New Madrid, 35; Memphis, 33, and Helena, 43 feet. The stages actually reached were: New Madrid, 33.9; Memphis, 33.0, and Helena, 43.4 feet.

The crest of this rise reached Memphis on January 14 and from that date until January 17 the river remained stationary at 33 feet (flood stage). During January 18 and 19 a very slight fall occurred, but on the following day the great flood wave, that two days before began pouring its waters into the Mississippi at Cairo was first felt at Memphis, and the river again took an upward turn.

On January 18, two days before the first appearance of the rise at Memphis, a special warning bulletin was issued and a copy sent to every post-office in the territory likely to be affected. This bulletin annouced that—

Owing to the unsettled weather conditions prevailing over the watershed it is impossible at this time to forecast the maximum stages that are likely to occur on the coming rise, but it is highly probable that a stage exceeding 36 feet will be reached at New Madrid and Memphis and above 46 feet at Helena. These stages will be reached in the next ten days.

On January 22 a third special bulletin was issued and extensively distributed by mail, telephone, and telegraph, and given special prominence in the daily papers. This bulletin announced that in the next ten days the stage at Memphis would be between 39 and 40 feet and that the maximum would be close to 40 feet, while a stage exceeding 49 feet was expected at Helena. It also advised all those having interests liable to be affected by an overflow to prepare in season. Ten days after the bulletin was issued the stage at Memphis was 39.8 feet and at Helena the river had risen to 49.3 feet.

On January 25, seven days before the arrival of the flood crest, a warning bulletin was issued as follows:

The Mississippi River will continue rising at New Madrid until next Monday (January 28) and come to a stand at 39 feet or slightly above. At Memphis it will rise until the last of next week (February 1 or 2) and reach a stage of 40 feet, or possibly higher. At Helena a stage of about 50 feet is indicated in the next ten days. At Memphis and Helena the expected increase above the present stage is 6 feet. All persons living or having interests in that part of the St. Francis basin lying west and south of Marion, Ark., are warned that an overflow is possible and should prepare at once for such a contingency.

From January 20 to 25 the rise was not as rapid as many thought it should have been, considering the rapid rise that had been in progress at Cairo during the previous six or seven days and the fact that the crest had about reached that station. This slow rise was a natural result of the overflow waters being deflected to the Reelfoot basin and other low places in the Tennessee bottoms. After all these low places became filled the fact was soon made apparent by a rapid increase in flood levels all along the line. The same difficulty in tracing the movement of flood crests occurred in 1903 and 1904, and until the completion of the levee now under contract that is to run from Hickman, Ky., to the high ground above Tiptonville, the purpose of which is to restrain the water from entering the Reelfoot basin, all future flood waves may be expected to follow a like course.

On January 28 the river at Memphis began rising at the rate of about one foot in twenty-four hours and the bulletin for that day announced that a stage exceeding 40 feet would be reached in the next six days. Whether the levee between Hollybush and Marion would be able to resist four feet more water was considered doubtful, and the situation at this time appeared serious. As this was the only section of levee north of Memphis regarding which there was any serious apprehension, the work of the engineers was concentrated at that place. Several hundred workmen with material and tools were hurried to reinforce the army of men that had been working day and night for several days, and every method known to levee engineering science was brought to bear in the efforts to prevent a break in the levee. Had a break occurred at Hollybush, a strip of country 30 miles wide and 60 or 70 miles long would have been submerged; and among other towns that would have been in the direct path of such a crevasse are Marion, Crawfordsville, Vincent, Edwards, and Earle, besides numerous milling settlements.

On February 1 the river had risen to 40 feet on the gage at Memphis, and during the early morning of that day the recently constructed levee in North Memphis gave way; a considerable portion of that section of the city was under water and many of the manufacturing plants along Wolf River were closed in consequence. The situation at Hollybush at this time was as serious as can be imagined. For days the labor of hundreds of men had been concentrated upon a strip of low, soggy levee about 1000 yards in length, where the water was held in check solely by the use of sacks filled with mud, the only available dirt. The river was then considerably above the crown of the levee, and the whole embankment was so soaked with water that it was in imminent danger of being carried away by the constantly increasing force brought against it. To prevent this a board wall was erected in front of the earth-filled sacks, with braces extending to the rear, a system of defence now extensively used, and as fast as possible fresh sacks were filled and piled along the top and sides. To add to the difficulty, a dense fog spread over the river and continued thruout February 1 and 2, most of the time being so thick that navigation was entirely sus-

pended, and workmen employed on the levee were fast deserting on account of the threatened danger. On February 3, however, a sudden change to colder weather hardened the surface of the wet earth, decreasing the danger from wave-wash, the sky cleared, and the river came to a stand at 40.3 feet, the highest stage on record.

The area flooded during the present rise was somewhat less in extent than in 1903, and owing to the fact that it occurred during the winter season the damage to crops and farm products was not as great as would have been the case had it occurred a month or two later. Being warned in ample time, all occupants of the lowlands subject to overflow were able to remove their property to places of safety and otherwise prepare for the coming flood. Most of the island plantations were submerged, and as usual in time of flood the stock and negro help were gathered upon mounds prepared for just such emergencies. On the east, the Tennessee bottoms and lands adjacent to the numerous small tributary streams were more or less flooded, but not as extensively as in 1903. For a time the Yazoo and Mississippi Valley Railroad tracks south of Memphis for several miles were lying in about 30 inches of water, which caused a partial suspension of traffic. On the west bank of the Mississippi the flooded area embraced only the lands lying outside the levee, the remaining portion of the St. Francis basin being saved from overflow by the protecting levee.

During the progress of the flood this office was at times overwhelmed with inquiries by telephone and telegraph from people in the city, as well as those living at far distant points. Extra copies of the daily river bulletin were printed for distribution by passing boats to river towns and settlements, and about 300 post-offices were supplied with each special bulletin issued. River forecasts were sent daily over the wires of the Iron Mountain and the Frisco railroads, as well as those of all telephone companies operating in eastern Arkansas.

While the stage at Memphis exceeded in height all previous records, the actual volume of water was much less than in either 1897 or 1903, and probably no greater than in 1904, when the maximum stage at Memphis was only 39 feet. In 1903 the river was above flood stage at Memphis fifty-four days against twenty-two days in 1907, and, as shown in the following table, the crest stages at all stations in the district except Memphis were higher in that year than during the recent rise:

Year.	Cairo.	New Madrid.	Fulton.	Memphis.	Helena.
1903	**50.6**	**39.5** −11.1	**40.1** −10.5	**40.1** −10.5	**51.0** +0.4
1907	**50.3**	**39.3** −11.0	**38.4** −11.9	**40.3** −10.0	**50.4** 0.1
	− 0.3	− 0.2	− 1.7	+ 0.2	− 0.6

Heavy-faced figures in the table, following those indicating the maximum stages, are the gage relations referred to Cairo. It will be seen that in 1903 the difference between Cairo and Fulton was 10.5 feet against 11.9 feet in 1907, showing an increased difference, or in other words there was a depression of 1.4 feet in the flood wave at Fulton where the maximum was 1.7 feet higher in 1903 than in 1907. At Memphis these conditions were reversed, the difference compared to Cairo being 0.5 foot less in 1907, and the maximum stage 0.2 foot above 1903. In 1903 there were two crevasses in the Arkansas levee, one at Hollybush and the other at Random Shot. The water that escaped thru these two breaks was sufficient to severely flood the lower half of the St. Francis basin, comprising several counties, and it is believed the flood plane at Memphis was thereby lowered at least 1.0 foot and possibly 1.5 feet. Again, in 1907 the flood wave was remarkably short considering its height, and as a very rapid decline immediately followed the passing of the crest, the latter was not as sustained as it would have been with a wave less abrupt. As a result the crest had a tendency to flatten or become deprest. The maximum stage at Cairo in 1907 was only 0.3 foot below that of 1903, while at Fulton it was 1.7 feet below, clearly indicating the depression in the flood wave at Fulton of 1.4 feet, before mentioned. This depression in the flood wave, due to the rapid decline after the passing of its crest, is shown to be more and more pronounced as the distance from its source increased, being especially noticeable at points below Helena. This being the case, and assuming that the crest depression at Memphis was about equal to that shown at Fulton, it follows that if we apply a correction to the 1903 record to cover the loss occasioned by crevasses, the gage relation between Fulton and Memphis is reestablished and the fact shown that the river was higher in 1903 than during the last rise.

Memphis, Tenn., to Vicksburg, Miss., by Mr. W. S. Belden, official in charge of the local office, U. S. Weather Bureau, Vicksburg, Miss.

The flood of January and February, 1907, was the first of its magnitude to pass from Cairo to below New Orleans without a break in the levees between these two places, and it was attended with higher stages thruout this district than were ever before recorded at this season of the year. The lower Mississippi River was remarkably high in November and December, and this condition, in connection with the two rises that culminated at Cairo in January, were the prime factors that produced the flood.

The stage at Vicksburg on January 4 was 36.2 feet. On that date a stage of 42 feet was forecast for this place, to be reached by the middle of January. On the morning of January 16 the stage was exactly 42 feet. Warning to prepare for a stage of at least 44 feet at Vicksburg was issued on January 8, two days before the first of the two rises reached Cairo. This warning was fully justified. Subsequent warnings for higher stages were issued from time to time while the second rise was in progress at Cairo. Early in February final crest stages as follows were forecast: Arkansas City, slightly more than 52, Greenville, 47.5, and Vicksburg close to 50 feet, the latter to be reached about the middle of February. The crest stages, with dates of occurrence, were as follows: Arkansas City, 52.1, or 10.1 above flood stage, February 8; Greenville, 47.3, or 5.3 above flood stage, February 8 and 9; and Vicksburg, 49.7, or 4.7 above flood stage, February 11. The water remained nearly stationary at Vicksburg from February 11 to 14. Fifteen days were required for the passage of the flood crest from Cairo to Vicksburg, and the water was above flood stage for forty-four days at Arkansas City, thirty-one days at Greenville, and thirty-two days at Vicksburg.

As a result of warnings issued by the Bureau, preparations for the high water were well under way before the flood stage was reached in the upper portion of the district. Between the river and the levees there was considerable cotton to be picked, and this work was rushed with excellent results. Planters secured necessary permission from insurance companies to run gins night and day, and large forces of pickers were placed in the fields. With the exception of a few rainy days the weather was generally favorable thruout the high-water period. Practically all cotton not protected by levees was picked, ginned, and shipped before the rising water forced a cessation of farming operations. Losses caused by the flood were almost wholly due to expense incurred in preparing for it and were mostly confined to the southern portion of the district. The southern portions of Issaquena, Sharkey, and Yazoo counties, and portions of Warren County, were overflowed by back water in the Yazoo River that extended up nearly to Yazoo City, where the maximum stage was 26.1 feet, or 1.1 feet above flood stage, on February 14. In this over-

flowed area the greater portion of the stock was kept on mounds, some of which have been built recently and can be utilized with a stage as high as 53 or 54 feet on the Vicksburg gage. Several of these mounds are near the mouth of the Sunflower River, which empties into the Yazoo River about midway between Vicksburg and Yazoo City. Where mounds were not available stock was moved well in advance of the rising water. By far the greater portion of the stock was moved before the water reached 46 feet on the Vicksburg gage. A total of about 2000 horses, mules, and cattle were taken by boat to Vicksburg, or to other places of safety. Davis Island, which is a part of Warren County, Mississippi, about 25 miles below Vicksburg, has a private levee approximately 14 miles in circumference. This levee can withstand between 48 and 49 feet on the Vicksburg gage. In the flood of 1903 it withstood the water when the stage was about 51 feet at Vicksburg, but a cut-off made by the river immediately above the island in April, 1904, had the effect of diminishing the efficiency of the levee. The island has a normal population of about 900 inhabitants, mostly negroes, who are employed on the few large plantations. Here not all the cotton crop was secured. It was estimated that 150 bales remained in the fields unpicked when the private levee broke on the upper side of the island on January 31. Thruout the overflow period a few people remained on the island and some stock was kept on mounds. But as a rule both the negro tenants and movable property were transferred to places of safety. Preparations to evacuate the island were made and some moving was done before the levee broke.

In Vicksburg about 12,000 bales of cotton were moved from a compress adjoining the Yazoo Canal, that was not protected by levees. This compress was overflowed when the water reached a stage of slightly more than 48 feet. As a matter of precaution, some cotton was also moved from a neighboring compress protected by a levee. Some cotton was shipped direct to the mills, but most of it was placed on vacant lots and along the sides of many streets thruout the city, which is about 200 feet higher than the river. Proprietors of warehouses on Levee street moved their goods from basements, but in only one instance did the water reach the first floor.

During the high-water period 500 river bulletins were disseminated thruout the district daily, except Sundays, and special bulletins were prepared Sundays and posted in conspicuous places in Vicksburg. At about 9 a. m. the river and weather information was telephoned to the State Levee Engineers at Greenville, Miss., and Lake Providence and Talullah, La. This information was of material assistance to the engineers and was much appreciated by them. In this connection Mr. E. J. Hamley, in charge of the State Levee Board office at Lake Providence, wrote as follows:

> We fully appreciate all that you have done for us in the way of keeping us posted in regard to high-water conditions, in which we are so vitally interested, and wish to take this opportunity to thank you for your promptness in all matters pertaining to your office.

The levees were patrolled during the time the water was high against the embankments, and men and material, with boats for transporting the same, were held in readiness to respond to emergency calls.

In regard to the levees the following information was furnished by Mr. M. P. Robertson, assistant state engineer of Louisiana, and Mr. C. H. West, chief engineer of the Mississippi Levee Board:

> The entire line of levees on the west side of the Mississippi from the Arkansas River southward to Delta, La. (opposite Vicksburg), has been enlarged and improved to a grade of not less than two feet above the highest water of record. The levees thruout the entire length of this stretch are much better cared for than in the past. There are no weedy levees, none previously wave-washed.
>
> The line of levees on the east side of the river from opposite Helena, Ark., to just above Vicksburg has been materially increased both in height and volume since the flood of 1903. That portion of the levee line most deficient in height and cross section is below Greenville, but the contracts now in force will very materially improve the condition along that portion of the line. A considerable portion of the levee above and all below Greenville will still have to be materially increased in height and volume of the embankment in order to give security against floods of the first magnitude.

Thru cooperation with the United States engineers the river gage readings made at Lake Providence, La., were telephoned to the Vicksburg office during the critical period and were published in the daily river bulletin.

The maximum stage attained at Lake Providence was 46.3 feet on February 9 and 10. The highest previous stage was 46.5 feet on March 27, 1903. The fact that the water was comparatively much higher at Lake Providence than at either Greenville or Vicksburg is due to the retention of the water between the levees. In 1897 and 1903 the levees on the Mississippi side broke above Lake Providence and allowed large volumes of water that had past the Greenville gage to flow out of the river. This water was again returned to the Mississippi at Vicksburg, hence also past the Vicksburg gage, but it escaped the Lake Providence gage.

The time the water past below flood stage at Arkansas City, in the upper portion of the district, was correctly forecast one week in advance, and at Vicksburg, in the lower portion, six days in advance. This time marked the beginning of the return of people and property to plantations that had been overflowed.

Vicksburg to the mouth of the river and the Atchafalaya River, by Mr. I. M. Cline, official in charge of the local office of the U. S. Weather Bureau, New Orleans, La.

The flood in the lower Mississippi River during January and February, 1907, is the earliest flood of record in this section, and in magnitude second only to that of March and April, 1903. The conditions which caused this flood, giving the second highest water of record, were materially different from those which obtained in connection with the flood of 1903. All of the flood waters in the present instance came from above Memphis, while in 1903 all the rivers below Memphis were carrying large volumes of water, which augmented the flood waters which came from the upper rivers as they reached the lower Mississippi. During the flood of 1903 the Atchafalaya River was taxed with flood waters from the Red and Ouachita rivers, but in 1907 the Red and the Ouachita were at low stages and the Atchafalaya served as a discharge for a large volume of flood waters from the lower Mississippi. The Bayou Lafourche, which during previous floods served as an outlet and carried a considerable volume of flood water to the Gulf, has been closed since the flood of 1903, and this is a matter which must now be taken into consideration, as the water that was carried off thru that channel must now reach the Gulf by way of New Orleans.

Flood warnings were issued on January 11 for stages of 17 feet at New Orleans, and 34 feet at Simmesport and Melville, La., on the Atchafalaya River, by January 21. On January 21 the stage at New Orleans was 16.7; at Simmesport, 34.5, and at Melville, 33.3 feet. The second warning was issued on January 15, when a stage of 18 feet was forecast for New Orleans by January 25. A stage of 17.5 feet was recorded on that date. On January 24 warnings were issued, which stated that stages between 45 and 46 feet would be reached at Natchez, 34 and 35 feet at Baton Rouge, 18 and 19 feet at New Orleans, 36 and 37 feet at Simmesport, and 34 and 35 feet at Melville by February 2. The following stages were recorded on that date: Natchez, 46.3; Baton Rouge, 34.1; New Orleans, 18.4; Simmesport, 37.9, and Melville, 35.4 feet. On January 29 warnings were issued for stages of 48 feet at Natchez, 35 feet at Baton Rouge, 19 feet at New Orleans, 37 feet at Simmesport, and 35 feet at Melville by February 8. At New Orleans the stage of 19 feet was reached on February 8, and the stages

forecast for other stations were reached by the dates named. On February 1 conditions appeared to be sufficiently well-defined to warrant a forecast of final stages, which was deemed necessary in the interests of the public, to enable them to properly cope with the situation, and the following warning was issued:

The Mississippi River at New Orleans will continue to rise slowly, and if the levees hold and brisk southerly winds should prevail during the passage of the flood crest, preparations should be made for a stage of about 20 feet at New Orleans and 36 feet at Baton Rouge between Feb ruary 15 and 25, and 49.5 feet at Natchez by February 18.

Warnings for final stages on the Atchafalaya of 42 feet at Simmesport and 38 feet at Melville, and on the Mississippi of 37 to 38 feet at Baton Rouge were issued later. The crest of the flood past Natchez on February 14, with a stage of 48.9 feet from February 12 to 14, inclusive; New Orleans on February 21, with a stage of 19.8 feet from February 13 to 21, inclusive, except that stages of 19.7 feet were recorded on February 18 and 20 as a result of winds; Baton Rouge on February 19, with a stage of 37.3 feet from February 14 to 19, inclusive; Simmesport on February 22, with a stage of 42.2 feet; and Melville on February 19 and 20, with a stage of 37.7 feet.

The warnings were given the widest possible distribution. Prompt action was taken to repair and strengthen levees. Where the levees in front of New Orleans were not above the high water of 1903, emergency levees were constructed. One such levee was constructed at the foot of Canal street, four blocks from the local office of the Weather Bureau, and but for this levee the water would have run into the city over an area several blocks wide. The water stood for several days against the emergency levee. The fact that the levees above New Orleans stood the strain of the high water without a break may in a great measure be attributed to the extra care and precautions taken as a result of the warnings of the Weather Bureau.

A break in the right bank of the levee at Jesuits Bend, 25 miles below New Orleans, occurred about 10 p. m. on the night of February 21. Material and laborers were promptly rushed to that point and efforts were made to close the crevasse, but without success. The river fell slowly after February 21 until a stage of 15.1 feet was reached March 10, after which a second rise commenced. When the river had fallen to a stage of 16 feet at New Orleans on March 5, the work of closing the crevasse was resumed vigorously with a view to completing the work before another rise, which was in sight, should set in. The crevasse was then 200 feet wide. The break was apparently successfully closed on March 16. Several sugar plantations, truck farms, and orange groves were flooded. The flood waters from the crevasse overflowed all the arable land on the right bank of the river below Algiers, La., and the damage resulting from the overflow will amount to several hundred thousand dollars.

The public was greatly pleased with the warnings issued by the Bureau, and the Times-Democrat, New Orleans, La., February 9, 1907, said:

The river reached 19 feet here yesterday, as forecast by the United States Weather Bureau eleven days ago. The forecasts have been exceptionally accurate, both as to the expected stages and the time of their occurrence.

There was a moderate freshet in the lower Tennessee River during the first few days of the month, due to the heavy and general rains of January 31 and February 1 over the Southern States. Warnings were issued for a stage of between 22 and 23 feet at Johnsonville, Tenn., flood stage being at 21 feet, and at 8 a. m., February 5, the stage of the river was 22.5 feet. The warnings were of much value to farmers and the lumber interests.

The same general rains caused decided rises in all the rivers of the Gulf of Mexico system east of the Mississippi River, but as a rule not to flood stages except in the Black Warrior and lower Tombigbee rivers. Warnings were promptly issued whenever necessary and there was no damage of consequence. As a matter of fact the floods were of much benefit to the lumber interests as the high water permitted the free movement of lumber that had been cut for the market.

About the time the Mississippi River flood was at its height, there was in progress another great flood thruout the Willamette Valley. It was caused by the heavy rains that fell over the north Pacific coast from February 1 to 6, inclusive, and was the greatest winter flood since that of 1890. While the waters rose to heights from 7 to 11 feet above the flood stages, no great amount of damage was done. The largest single loss was probably that of the boathouse of the Portland Rowing Club, valued at about $10,000. A considerable quantity of logs, lumber, and fencing was carried down the various streams, but the loss was comparatively small. The flood warnings were issued first on February 4 and frequently thereafter until the waters had receded below the flood stages. The following item from the Portland Oregon Journal of February 9, 1907, relative to the flood warnings will be of interest:

Merchants having goods stored along the water front saved thousands of dollars by the splendid reports and warnings issued by the Weather Bureau. Relying upon the efficiency of the service, they did not go to the expense of removing goods from localities which the water would have reached had it risen a few inches more. Forecaster Beals estimated the rise to an inch nearly 48 hours in advance, and many merchants staked thousands of dollars' worth of goods on the correctness of his estimate. They are now complimenting the service.

The following brief account of the flood was prepared by Mr. E. A. Beals, district forecaster in charge of the Portland, Oreg., Forecast District.

Between February 1 and 6, 1907, heavy rains fell in the basin of the Willamette River, and as they were followed by moderate temperatures and had been preceded by sufficient rain to thoroly saturate the soil, they caused the highest winter flood in the Willamette River since February, 1890. Fig. 1 shows the amount and distribution of the precipitation that caused the flood, and fig. 2 hydrographs for four stations on the main stream.

Warnings for this flood were first issued on Monday, February 4, when stages of 15 feet Tuesday and 17 feet Thursday were forecast for Portland, 23.5 feet Wednesday for Salem, and 25 feet Tuesday for Albany. These first estimates were somewhat too low and the next morning they were raised, as follows: Portland to 21 feet by Friday, Salem to 30 feet in thirty-six hours and Albany to 30 feet in thirty hours. The next morning, which was Wednesday, February 6, the estimate for Portland was raised one foot, but no changes were made in those for Salem and Albany. The crest past Albany at noon on February 6, at a stage of 30.8 feet, or 0.8 foot higher than the stage forecast, and Salem at 6 p. m. the same day at a stage of 31.3 feet, or 1.3 feet higher than forecast. The next morning the stage expected at Portland was raised 0.5 foot, or 22.5 feet, and this was the exact stage reached at midnight February 7–8, sixteen hours after the forecast was made.

Owing to the accuracy and timeliness of the warnings the losses were very small and consisted principally of the loss of saw logs and houseboats which broke away from their fastenings and drifted down stream. The houseboats were mostly recovered, tho in a damaged condition, but the logs were a total loss. The wharves on the river are built with upper and lower docks, the latter being used during low water and the former during floods. Large quantities of merchandise had accumulated on the lower docks which had to be moved to the upper ones. Altho there were thousands of tons of goods in the cellars and on the lower docks which had to be moved during this flood, the only losses so far as learned consisted of about five hundred dollars' worth of baled hay which was caught during the second day of the flood. This hay was not

a total loss, as much of it was saved and afterwards dried so as to be used.

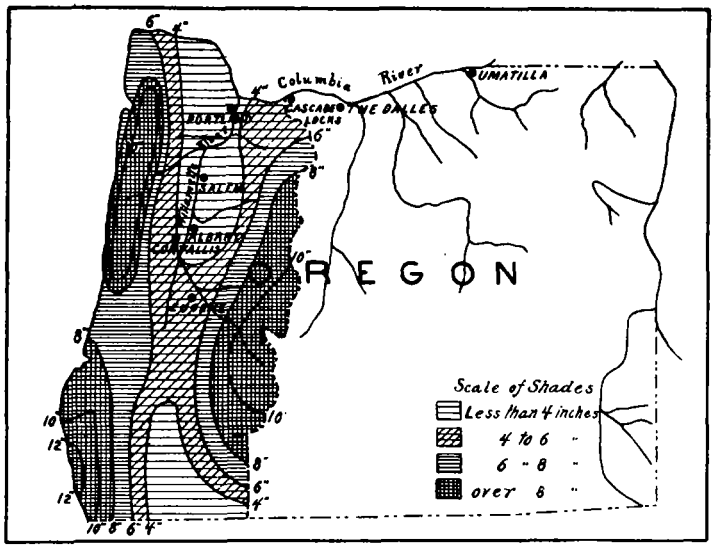

FIG. 1.—Precipitation in western Oregon from February 1 to 6, 1907, inclusive.

The same general rains also caused flood stages thruout the upper Sacramento Valley, but nothing of a serious nature developed.

The Missouri River opened at Omaha, Nebr., on the 18th, but remained generally frozen above. There were ice gorges at times above Sioux City, Iowa, especially from Vermillion, S. Dak., southward, and about 100 square miles of farm lands were inundated. There was no change in the upper Mississippi River, and it remained frozen as far south as Leclaire, Iowa. The upper Allegheny River was frozen during the

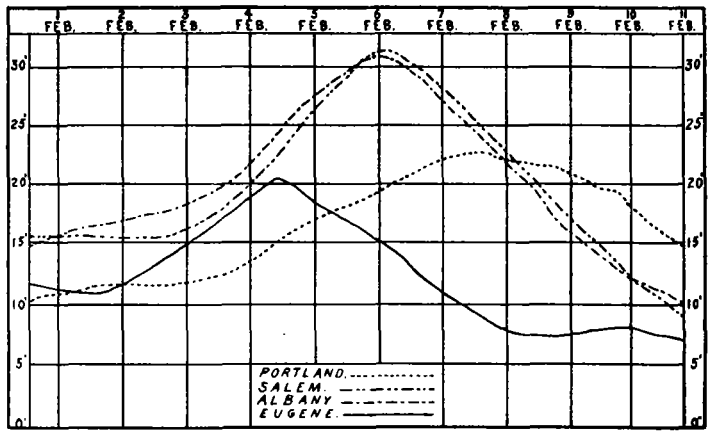

FIG. 2.—Hydrographs for four stations on the Willamette River, February 1 to 11, 1907.

greater portion of the month, as were also portions of the Scioto and Sandusky rivers of Ohio. The rivers of New England and the Middle Atlantic States continued closed thruout the month.

There was considerable ice in the Columbia River about the time of the Willamette flood, and navigation was greatly interrupted, and at times suspended.

The highest and lowest water, mean stage, and monthly range at 300 river stations are given in Table VI. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississipi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

NORTH ATLANTIC WEATHER.

By Mr. JAMES PAGE, Chief of the Division of Ocean Meteorology.

[Compiled from the daily observations, at Greenwich mean noon, furnished by cooperating observers at sea.]

The Greenwich mean noon synoptic weather chart for February 1 shows two well-defined areas of high pressure covering the eastern half and the western half of the ocean, respectively; the former central in latitude 50° north, longitude 15° west, and exhibiting maximum barometric readings of 30.60 inches; the latter central over the Gulf of St. Lawrence, with maximum pressure of about the same intensity. The axis of the trough of low pressure separating these two highs extended from the parallel of 50° to the parallel of 34°, in an almost due north and south direction along the meridian of 37° west. On the eastern slope of this trough southerly gales of force 8 and 9 prevailed, the belt of high winds extending in width eastward to the meridian of 29° west. On the western slope, northerly and northwesterly gales extended as far as 50° west. The shift of the winds experienced by westward bound vessels crossing the line of minimum pressure was in all cases almost instantaneous.

Thruout the day this distribution moved slightly to the eastward, its principal features remaining intact. At Greenwich mean noon of February 2 the trough of low pressure was roughly coincident with the meridian of 28° west. In the rear of the American high, pressure gave way rapidly, a wedge-shaped prolongation of a cyclonic area central over the Great Lakes suddenly extending eastward across the New England coast, giving rise to southeasterly gales along the transatlantic routes as far eastward as longitude 55°. Thruout February 3 and 4 this cyclonic area was stationary over the Gulf of St. Lawrence and Newfoundland. During February 5 pressure in this region underwent a marked increase, coincident with the appearance of a decided local depression off the coast of New Jersey. The latter, altho accompanied by cyclonic winds of force 10 and 11, was of brief duration, no evidence of its existence being apparent upon the chart of February 6.

Moderate weather prevailed over the entire ocean February 7 and 8.

On February 9 a marked area of low pressure developed to the northward of Bermuda, and moving eastward gave rise to the most severe storm experienced during the month. On the 10th the position of the center (minimum pressure 28.90 inches) was latitude 43° north, longitude 52° west, the center being surrounded by a completely developed system of cyclonic winds of full hurricane force. The course of the depression was about east-northeast; it was attended thruout by violent gales in its southern and western quadrants, and finally crost the British Isles February 12.

Moderate weather was continuous from February 14 to 22, the salient feature of the pressure distribution thruout this interval being a strengthening of the high over the Azores, the pressure thereabouts ranging from 30.40 to 30.60 inches. Thruout the same period Newfoundland was covered by the characteristic low area, and on several days the gradients became of sufficient steepness to occasion winds of gale force thruout the intervening region, the area affected being in general limited by the parallels 40°–45° north, and the meridians 40°–55° west.

On the 18th of the month pressure over Iceland fell below 28.60 inches, accompanied by hurricane winds along the